Distribution Math Study Guide

Kentucky Division of Compliance Assistance
Certification and Licensing Branch

This study guide is intended to help students become more familiar with the variety of math equations within the Distribution manual and exam.

Below is a chart of where math can be found in the training manual.

Chapter	Name	Page	Concept
3	Storage	34	Conversions
3	Storage	38	Demand
4	Disinfection	42	Demand/Dosage/Residual
4	Disinfection	50	lbs formula and % purity
4	Disinfection	50	Strength of Solution
4	Disinfection	53	Lbs formula % and Specific Gravity
9	Meters	126	Water Loss and meter error
10	Hydraulics	133	Q = A x V
10	Hydraulics	138	Head vs psi conversion
10	Hydraulics	148	C-factor (need chart)
10	Hydraulics	154	Equivalent Flow rate
10	Hydraulics	155	Rule of continuity (includes velocity)
10	Hydraulics	171	Static Discharge Head; Total Static Head
10	Hydraulics	175	Electrical Cost
12	Corrosion	189	Langeliers Index

Work through each problem introduced in each chapter and the math questions (if any) at the end of each chapter.

Class I & II

1. If your distribution system is serving 1,000 people who are using an average of 125 gallons per day per person, what would your daily demand be?

      A.   1000 gallons
      B.   8,340 gallons
      C.   12,500 gallons
      D.   125,000 gallons

2. What is the flow rate of wastewater, in gallons per minute, through a plant that treats 2 million gallons of water during an 8 hour shift?

      A.   694.5 gpm
      B.   1389 gpm
      C.   2880 gpm
      D.   4167 gpm

3. What is the flow rate if it takes a pump 1 minute and 15 seconds to fill a rectangular tank 3 feet wide and 4 feet long to a depth of 5 feet?

      A.   359 gpm
      B.   390 gpm
      C.   420 gpm
      D.   480 gpm

4. How many 24 ft section of pipe will be needed to replace 2 miles of 8" pipe?

      A.   110
      B.   220
      C.   440
      D.   880

5. How many lbs of 65% available calcium hypochlorite would be needed to treat 50,000 gallons of water at a rate of 200 gpm to the desired dosage of 3.0 mg/L?

    A.   1.25 lbs
    B.   1.92 lbs
    C.   12.5 lbs
    D.   19.2 lbs

6. How many pounds of calcium hypochlorite (70% available chlorine) will it take to disinfect a new 8 inch pipe that is 1.5 miles long?

    A.   4.3 lbs
    B.   5.6 lbs
    C.   12.51 lbs
    D.   18.35 lbs

7. What is the amount of chlorine required to treat 900,000 gallons of water to provide a 0.9 ppm residual and satisfy a 3.0 ppm chlorine demand?

    A.   6.75 lbs
    B.   15.79 lbs
    C.   22.5 lbs
    D.   29.27 lbs

8. Water flows through a 10" pipe at a rate of 3.5 cubic feet per second. What is the velocity of the water flowing through this pipe?

    A.   3.5 f/s
    B.   6.5 f/s
    C.   7.8 f/s
    D.   9.1 fps

9. Water flows through a 12" pipe at a rate of 6.0 ft/second. What is the flow in ft³/s?

       A.   4.71 ft³/s
       B.   7.61 ft³/s
       C.   448.8 ft³/s
       D.   2113.8 ft³/s

10. You have been pumping water to a neighborhood water system for 90 days. The beginning master meter reading was 5,750,000 and 90 days later the same meter read 14,350,500. What was the average flow in gallons per day?

       A.   15,945 gpd
       B.   95,561 gpd
       C.   223,339 gpd
       D.   575,000 gpd

11. How many gallons of water are in a tank 72 inches in diameter by 30 feet high when the water is 16 feet deep?

       A.   564 gallons
       B.   785 gallons
       C.   3382 gallons
       D.   3771 gallons

12. How many pounds of 65% HTH powder will be required to disinfect a 20,000 gallon tank?

       A.   12.8 lbs
       B.   8.34 lbs
       C.   5.4 lbs
       D.   0.6 lbs

13. A reservoir is an average of 65 feet deep and when full, holds 220 million gallons. One pump draws 9,000 gpm for 8 hours per day while another pump drew 12,500 gpm for 4 hours per day. At 8:00 AM Monday morning, the reservoir level was at 55 feet, at 8:00 AM Tuesday morning, what was the water level in the reservoir? Assume no rain or other inflow or outflow.
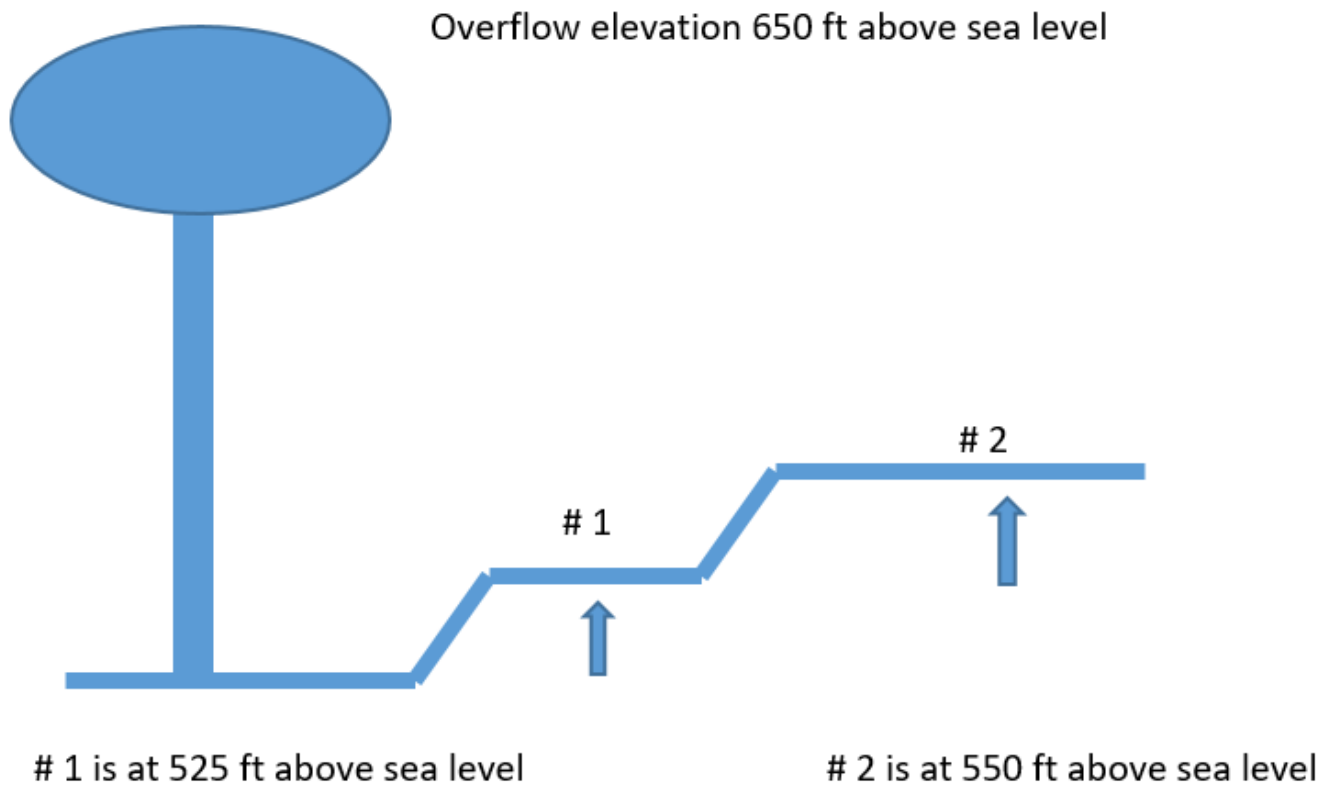
    A. 55 ft
    B. 53 ft
    C. 57 ft
    D. 35 ft

14. A new waterline 8 inches in diameter must be disinfected with 5.25% bleach with a specific gravity of 1.2. Since the pipeline is 8,000 feet long, how many gallons of bleach will be needed?

    A. 9 gallons
    B. 14 gallons
    C. 17 gallons
    D. 19 gallons

15. You are going to clean and disinfect a water tank. After you have cleaned the tank, you will prepare a 250 ppm solution of water and chlorine bleach that will be used to swab the sides of the tank. To prepare the solution, you mix 5.25% chlorine bleach with water for a final volume of 40 gallons of disinfectant. 1 gallon of the bleach weighs 8.5 lbs. How much bleach will be required for this solution?

    A. 0.19 gallons
    B. 0.8 gallons
    C. 1.9 gallons
    D. 2.7 gallons

Refer to the following figure for questions 16 and 17.

Overflow elevation 650 ft above sea level

1 is at 525 ft above sea level

2 is at 550 ft above sea level

16. What will the static water pressure be at location #1?
    A.   50 psi
    B.   54 psi
    C.   60 psi
    D.   70 psi

17. What is the difference in pressure between location # 1 and location #2?
    A.   0.psi
    B.   5 psi
    C.   10.8 psi
    D.   25 psi

18. Water flows through a 18" pipe at a rate of 900 gpm. What is the velocity of the water flowing through this pipe?

    A.   0.05 f/s
    B.   0.75 f/s
    C.   0.9 fps
    D.   1.1 fps

19. Calculate the water horsepower of a pump required to move 850 gpm against a head of 210 feet?

    A.   45 WHP
    B.   50 WHP
    C.   55 WHP
    D.   60 WHP

20. What would be the BHP of the pump in question 19 if the pump efficiency was 90%?

    A.   45 BHP
    B.   50 BHP
    C.   55 BHP
    D.   60 BHP

Answer Key

1. D	11. C
2. D	12. B
3. A	13. A
4. C	14. D
5. B	15. A
6. C	16. B
7. D	17. C
8. B	18. D
9. A	19. A
10. B	20. B

Class III & IV

21. A reservoir has a capacity of 70 million gallons and can hold 35 feet of water when full. The plant treats water at the rate of 100 MGD for 24 hours into the reservoir. A pumping station delivers water from the reservoir to the distribution system at the rate of 36 MGD for 8 hours and 90 MGD for 16 hours. At the beginning of a day the water was 4 ft deep. At the end of the 24 hour period, how deep would the water be in the reservoir?

      A.   10 ft
      B.   18 ft
      C.   24 ft
      D.   35 ft

22. A water main is 1600 ft long and has an inside diameter of 12 inches. The flow through the main is 700 gpm. The main is 10 year-old DIP with a known C-Value of 100. What is the loss in feet of head per 100 ft? Use the Friction Loss of Water chart on page 148 of the Distribution System Operator Certification Manual.

      A.   0.22 ft
      B.   1.99 ft
      C.   2.12 ft
   D.   3.52 ft

23. From the previous question. There is no elevation change throughout this section of pipe. If the system pressure is 60 psi at the beginning of this section, what should the pressure be at the end of the section?

      A.   26 psi
      B.   58.5 psi
      C.   60 psi
      D.   61.5 psi

24. If water flow past any given point is at the rate of 2.4 ft³/sec, how many gallons will flow past this point in 1.5 minutes?

     A.   1615 gallons
     B.   2455 gallons
     C.   3300 gallons
     D.   4566 gallons

Refer to the following Figure for question 25.
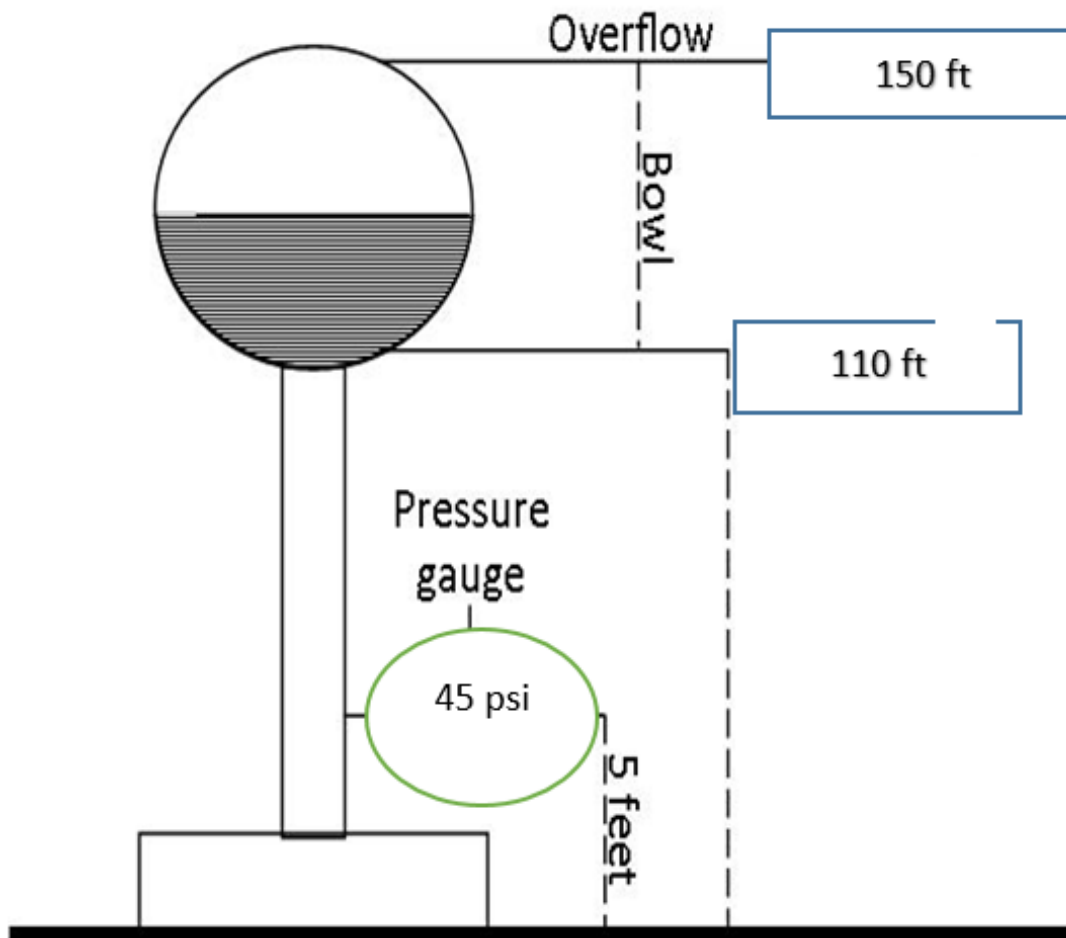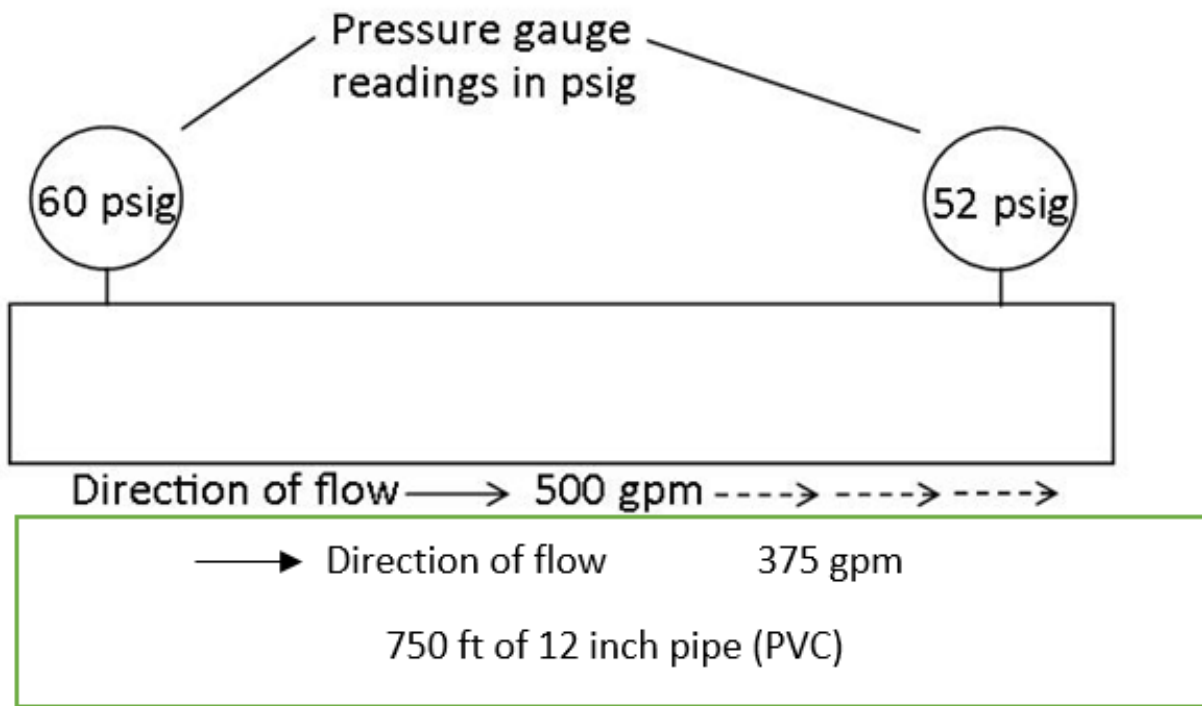

25. What will the pressure gauge read when the water level rises to the overflow?

     A.   18 psi
     B.   65 psi
     C.   63 psi
     D.   108 psi

26. How much would it cost to run a 65 MHP pump for two off-peak 8 hr shifts if the charge for power is $0.08/kWhr?
   A. $31.04
   B. $42.00
   C. $55.86
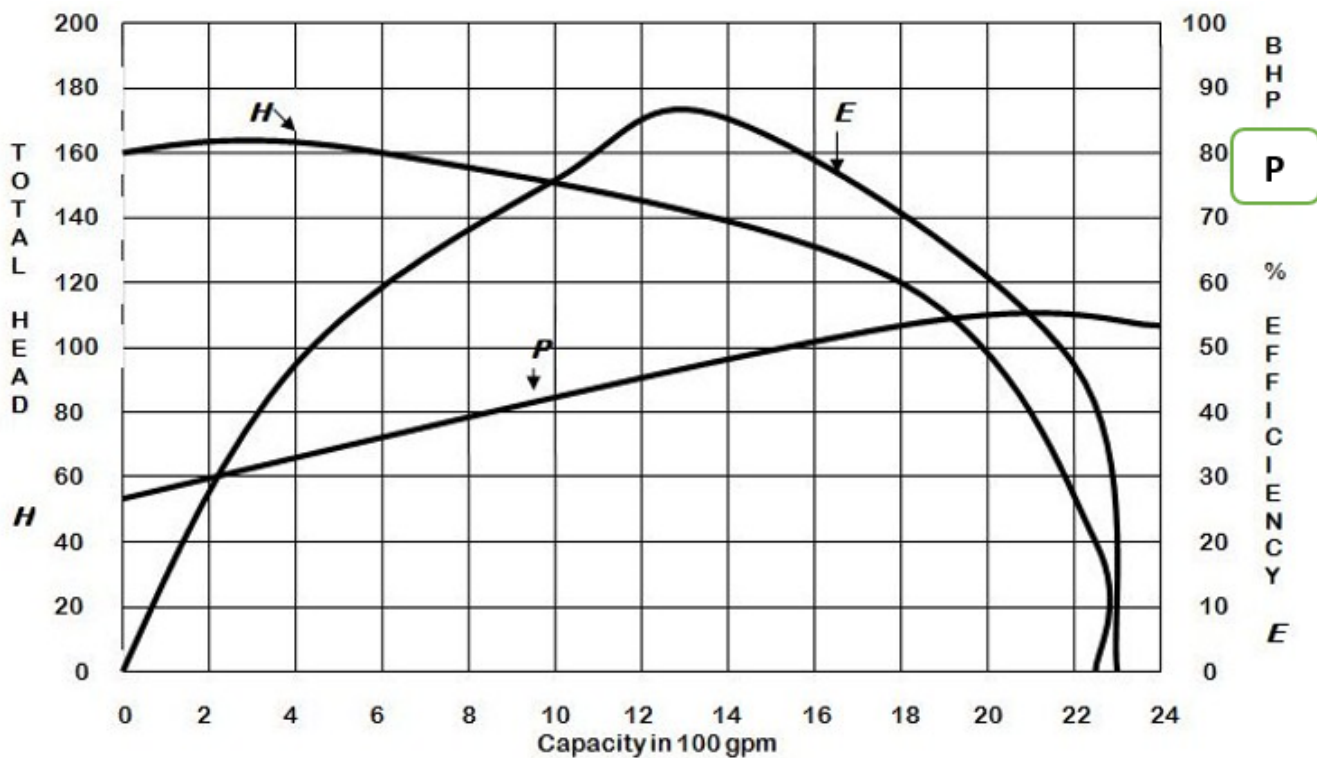   D. $62.06

Refer to the following Figure for question 27.

Pressure gauge readings in psig

60 psig   52 psig

Direction of flow ⟶ 500 gpm ----> ----> ---->

     ⟶ Direction of flow   375 gpm

750 ft of 12 inch pipe (PVC)

27. Determine the head loss across the pipeline.
   A.   9 ft
   B.   18.5 ft
   C.   27 ft
   D.   36 ft

Refer to the following Figure for questions 28, 29 and 30.

28. What is the capacity of the pump in gpm when the pump is operating at its highest efficiency?

      A.   13 gpm

      B.   200 gpm

      C.   1300 gpm

      D.   2000 gpm

29. Which of the following statements is correct based on the data presented in the graph?

      A.   Loss of pressure head is constant throughout the range of capacity of the pump.

      B.   The most efficient pump operation occurs when pumping 1000 gpm.

      C.   Power needed decreases with increasing capacity

      D.   The pump would not be running efficiently when the capacity exceeds 2000 gpm

30. The greatest efficiency of the pump is when it is pumping between

       A.   600 - 2000gpm
       B.   1200 - 1400 gpm
       C.   400 - 1000 gpm
   D.   1800 - 2200 gpm

31. What water horsepower is required to lift water from a reservoir that is 20 feet below the centerline of the pump and then raise it to an elevated storage tank that is 90 feet above the centerline of the pump? The pump will need to deliver water at a rate of 3.5 ft³/s.

       A.   43.6 WHP
       B.   57.8 WHP
       C.   62.1 WHP
       D.   Pumps cannot lift water 20 ft.

32. You are flushing an 8 inch pipe. Flow from the hydrant is 350 gpm. What is the velocity of water in this pipe?
A.   0.35 f/s
B.   0.79 f/s
C.   2.26 f/s
D.   7 f/s

Refer to the following Figure for questions 33, 34 and 35.

Elevation = 182 ft

Reservoir

Elevation = 37 ft

Pump

Reservoir

Elevation = 25 ft
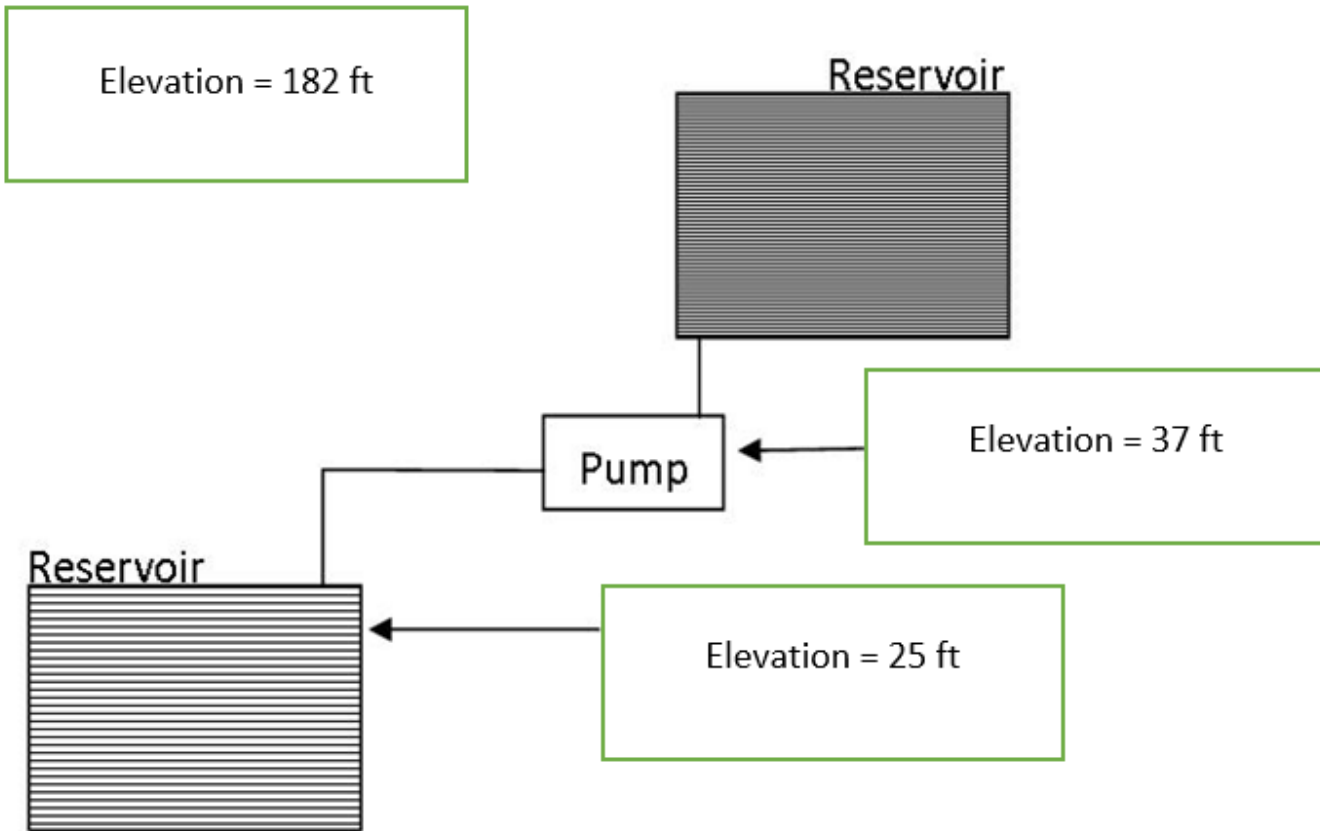
33. For the arrangement of water source, pump and reservoir what is the total static head in feet?

    A.   157 ft
    B.   145 ft
    C.   62 ft
    D.   12 ft

34. For the arrangement of water source, pump and reservoir what is the static discharge head in feet?

    A.   157 ft
    B.   145 ft
    C.   62 ft
    D.   12 ft

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35. For the arrangement of water source, pump and reservoir what is the total static suction lift in feet?

      A.   157 ft
      B.   145 ft
      C.   62 ft
      D.   12 ft

In
8 inch pipe
700 gpm

A (out)
6 inch pipe
500 gpm

B (out)
4 inch pipe
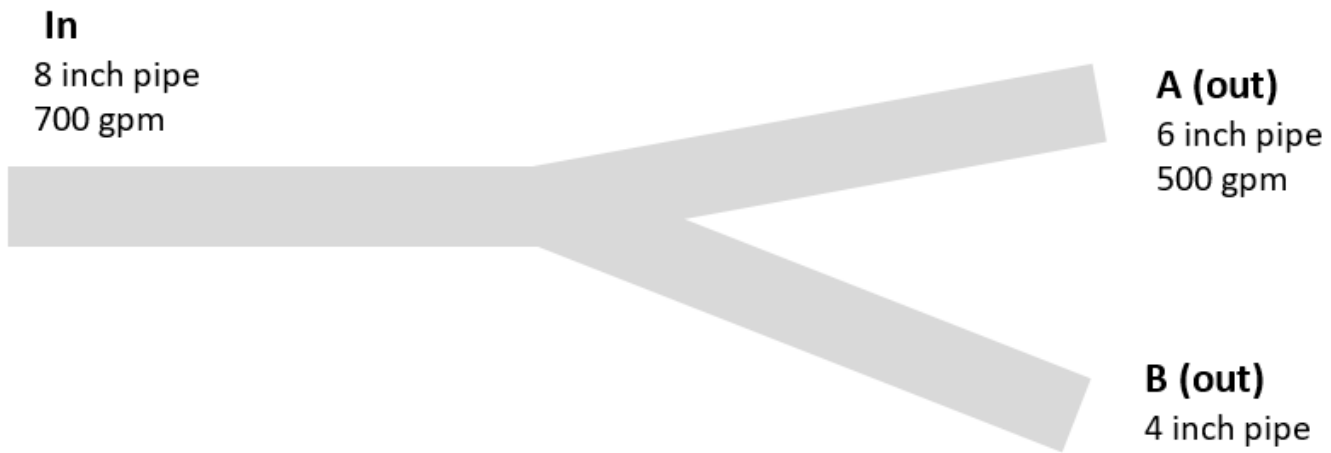
36. From information in the above diagram, what will be the velocity in f/s of water in pipe B?

      A.   1.4 fps
      B.   4.4 fps
      C.   5.2 fps
      D.   5.8 fps

37. A 10 inch line is flowing at 1440 gpm and has a starting pressure of 85 psi. The pipe is estimated to have a C-Factor of 120. The pipe system is 1,600 feet long through flat terrain. What will be the approximate ending pressure of the line discounting any valves or restrictive appurtenances in the line? Use the Friction Loss of Water chart on page 148 of the Distribution System Operator Certification Manual.

      A.   51 psi
      B.   67 psi
      C.   75 psi
      D.   81 psi

Answer Key

21. B	30. B
22. A	31. A
23. B	32. C
24. A	33. A
25. C	34. B
26. D	35. D
27. B	36. C
28. C	37. C
29. D	

Questions or Concerns?

The Kentucky Operator Certification Program provides training and issues certifications to ensure that individuals engaged in performing many of Kentucky's critical environmental activities are qualified and capable to perform their duties. DCA staff are available to provide on-site assistance and training.

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